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ABSTRACT

A study to evaluate four different black and white slow-scan television (SSTV) systems as information delivery systems was conducted using four classes of university students, one at the graduate level and three at the undergraduate level. Each class viewed videotaped examples from the four SSTV systems during one class period, and were asked to rate various physical characteristics of each system, using a questionnaire, and to then rank the systems in order of preference. Faculty members attended demonstrations which featured one of the SSTV systems, and were subsequently interviewed to determine their perceptions of the systems. Results indicated that students preferred a top-to-bottom scan, medium resolution, and a frame time of 8 to 10 seconds; they ranked the Robot Model 630 as most desirable. Interviews with faculty indicated that, while they accepted the concept of SSTV, all but one had no immediate application to their respective areas. The appendices include the script of the test program, the student questionnaire, a comparison of the SSTV systems, and a tabulation of voice and videocircuit transmission costs. Thirty references are provided. (Author/BK)

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A TEST OF FOUR SLOW-SCAN TELEVISION SYSTEMS FOR REMOTE TEACHING

by

DONALD CRESWELL PETERS, JR.

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by Donald Creswell Peters, Jr.

Developed as a special problem submitted in partial fulfillment of the requirements for the degree of Master of Continuing Education at Washington State University.

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AUTOBIOGRAPHICAL SKETCH

The author, Donald Creswell Peters, Jr., was born and raised in Pasco, Washington, where he graduated from Pasco High School. He graduated from Washington State University in 1969 with a B.A. in Communications. He holds a First Class Radio-Telephone License issued by the Federal Communications Commission. After commissioning as a Second Lieutenant in the US Army Signal Corps, the author was a television writer-producer at Ft. Gordon, Georgia. Later, he served as a Detachment Commander of an Armed Forces Viet Nam Network Radio-Television facility in Qui Nhon, South Viet Nam. Upon discharge as a First Lieutenant, he was an Audio-Visual Coordinator for American Sign and Indicator, Spokane, Washington, for three years, where he worked with film and television.

He served as a broadcast engineer for KWSU television, Pullman, Washington, and later became a television producer-director for Instructional Media Services at Washington State University.

A TEST OF FOUR SLOW-SCAN TELEVISION SYSTEMS FOR REMOTE TEACHING

ABSTRACT

by Donald Creswell Peters, Jr., M.A.C.Ed.
Washington State University, 1979

Chairman: James S. Long

The purpose of this study was to evaluate four black and white slow-scan television (SSTV) systems as informational delivery systems in remote teaching situations. Slow-scan television was a branch of communications technology which allowed television signals, normally requiring wide bandwidth transmission channels such as cable, microwave or satellite, to be transmitted over audio channels such as telephone circuits. By increasing the time for an image to be scanned or constructed upon the screen to several seconds or minutes, the required bandwidth was reduced by a factor of 1000 or more. Motion in the transmitted image was not allowed, but the reduction in cost of sending aural and visual messages over regular telephone lines was attractive to remote teaching applications. The interactive nature of SSTV made it appealing as an adult and continuing education tool. Available commercial SSTV systems utilized various resolutions, scanning or frame times, and direction of scanning.

The literature indicated that SSTV had been used for instructional and scientific purposes with varying degrees of success. Though several SSTV systems with various characteristics were available, no attempt had been made to ascertain student perceptions of those systems. This study measured how university students rated characteristics of four SSTV systems and which of the four they perceived as most applicable to instructional usage.

The project consisted of an evaluation of equipment and line charges, an experiment in which student response to four selected SSTV systems was elicited, and an informal query of selected faculty members as to application of SSTV in their respective areas. It was hypothesized that student evaluators would prefer a system with top-to-bottom scanning, resolution approximating that of home television reception, and approximately a 30 second frame time. A correlary supposition was that faculty would prefer a face-to-face mode of instruction, followed by two-way television, but would accept SSTV as a viable instruction communications system.

The four SSTV systems compared were: the Robot Research Model 530, the Robot Model 630, the Colorado Video, Incorporated Model 275A, and the CVI Model 275B. A short instructional program with ten visuals and accompanying narration was transmitted through each system and recorded on videotape.

A questionnaire addressing characteristics such as resolution, frame time and direction of scan was constructed and field-tested. After revision of the instrument, the four

videotaped examples were shown to university student subjects who were asked to rate various physical characteristics of each system and then rank the systems in order of preference.

Results indicated students preferred a top-to-bottom scan, medium resolution, and a frame time on the order of 8 to 10 seconds. Tape 3, the Robot Model 630, which had a top-to-bottom scan, a 35 second frame time, and a resolution of 256 horizontal by 256 vertical elements, was ranked as most desirable. The rank ordering of the four tapes was tested for significance by the Friedman two-way analysis of variance by ranks. For df=71, the difference in ranking was found to be significant; $p<.001$. Thus the first hypothesis was supported.

Interviews with faculty members indicated that while they accepted the concept of SSTV, all but one had no immediate application to their respective areas, thus in the author's opinion, SSTV was not accepted in fact. The supposition regarding faculty acceptance of SSTV was not supported.

The study also indicated equipment specifications of other commercial (SSTV) systems in addition to those tested. Information was compiled which compared telephone to microwave charges. Suggestions were made for the development of a hybrid SSTV system which appeared to meet the needs of remote teaching.

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CHAPTER 1

INTRODUCTION

Purpose of the Study

The purpose of this study was to evaluate four black and white slow-scan television systems as informational delivery systems in remote teaching at the college level.

Background

With the invention of new communications devices, namely motion pictures, radio, and television, there were predictions that these new technologies would produce a "revolution in adult education as then practiced. These notions emerged from diviners as diverse as Maxim Gorki (movies), David Sarnoff (radio), and Frank Stanton (television). So far, these mass media have not produced the hoped-for revolution" (Gordon cited in Niemi, 1971, pp.10-11). There have been some outstanding examples of mass media operating successfully in adult education. During World War II the motion picture industry was mobilized to produce training films and the motivational "Why We Fight" series. The latter series had a marked effect on knowledge of factual material as well as on opinion change (Hovland, 1965).

In 1956, the Chicago Board of Education experimented with the presentation of a complete junior college curriculum on open-circuit educational television as a supplement to its regular junior college activity located throughout the city. Television students were required to do the same outside work and take the same examinations as resident students. Television students mailed in assignments, were permitted to phone instructors, and could arrange face-to-face conferences. Some of the major findings from that experiment were:

1. About two-thirds of the credit students finished the course which they began.
2. Retention rate was higher in courses where teacher-student interaction was high.
3. Most students who took TV courses at home said they liked them and would want to take more such courses.
4. While first year studies showed no significant difference between on-campus and TV class achievement, in the third year of the study, many courses began to show more learning from TV at home (Miller, 1964, p.278).

Despite the successful use of the medium indicated by the Chicago experiment, other education or public television stations had developed little in continuing education. Their participation had been limited to occasional telecoursesor daytime school programming. David Rauch stated the majority position. "Educational television has brought outstanding cultural stimulation to the population. But TV unfortunately lacks opportunity to discuss with others or to talk back to the 'knowledge merchants'" (1972, p.3).

The problem appeared to be making education fit the parameters of mass media rather than adapting media to education. As Wedemeyer (Neimi, 1971, p.51) indicated,

> Hopefully, what may in time result is a technology of education, an indigenous technology that includes what has been borrowed, but that through a synergistic process becomes a unique and specialized technology in itself. Education is a humane process; the elements that will eventually compose a technology of education must, then, go beyond the hardward and equipment (that provide means) to an inclusion of the human and the humane in processes that place software above hardware, and the teacher and the learner above software and that express primary concern with the ends of education.

Wedemeyer's evaluation of the perspective of educational technology fits nicely the philosophy of adult education where sensitivity to the needs of the learner is paramount. As Knowles (1975) indicated, the teacher must become a facilitator of learning. The facilitator must focus upon what is happening within the student. This mode of instruction, of necessity, requires interaction, thus dictating a two-way, real-time communications system. Feedback is an essential part of the learning situation. "So important is this fact in its many ramifications that some psychologists, and some poets, have said that all learning is dialog--between learner-author, or learner-teacher, or learner-fellow-learner" (Kidd, 1959, p.217).

To meet the adult education paradigm, ideally, one would use personal interaction. There are constraints which do not always allow face-to-face situations. These may be due to travel, money, time, or other restraining factors. However, when teaching at a distance, or simultaneously teaching persons located at several locations, two-way television makes possible

interaction with many of the qualities of face-to-face interaction--visual, aural, non-verbal, etc. Television requires a great deal of bandwidth in the transmission of its signals, and therefore the cost is great. In general, as bandwidth is increased, the system becomes progressively "transparent" and approximates the communications of an in-person conversation (Hubbard, 1977). That is, two-way television simulates vis-a-vis communication more than a telephone call, for example.

Two-way television has been used to carry on some very important facets of adult education. "Full two-way interactive television is perhaps the only technology for bringing the medical school classroom to the small community hospital and simultaneously bringing the community health professional to the university classroom" (Blakely, 1974, p.20). That was the rationale behind the development of the New England Microwave Network which connected Dartmouth's Medical School and University Hospital of Hanover, N.H. with Clarement General Hospital in Clarement, N.H., 30 miles away.

> Both Texas and Indiana have established a system [sic] of microwave links to tie together all major institutions of higher education in their respective states. The Texas Educational Microwave Program (TEMP) and the Indiana Higher Education Telecommunication System (IHETS) involve complex arrays of microwave channels, computerized scheduling, and small but efficient centralized operations to beam a wide variety of specialized materials from campus to campus. Technical demonstrations, medical information, special guest lectures, and shared content courses can all be transmitted among different institutions using the TEMP and IHETS facilities (Wood and Wylie, 1977, p.273).

Realizing the possibilities of such a two-way television system for the State of Washington, the Washington State University

General Extension Service, in 1969, requested the Washington State University Audio Visual Center to study the feasibility of a telecommunications network system which would connect the university with five communities in Eastern Washington (Hardie, et al, 1971). Under the chairmanship of James W. Hardie, Coordinator of Instructional Television, an extensive university-wide study was undertaken to evaluate the implications of this system. The recommendation forwarded to the WSU administration was, ". . . that a state-wide multipurpose telecommunications network system is not only technically feasible, but will become imperative in a relatively short time" (Hardie, et al, 1971, p.5). The cost for a two video duplex channel system connecting Spokane, Pullman, Richland, and Seattle was $333,180 per year. This figure was only the yearly microwave costs for interconnection of sites. While the administration embraced and endorsed the concepts recommended by the committee report, the cost involved exceeded the university's resources.

In 1972, a formal proposal was made to the Fund for the Improvement of Post-Secondary Education, Department of Health, Education, and Welfare. The title was "A Multipurpose Communication Network Prototype" (Hardie et al, 1972). This proposal requested 5 million dollars over three years to implement this prototype system. It was to link the WSU campus with the following locations: in Spokane, community colleges, four year institutions, WSU Extension Center, Nursing Center, Sacred Heart Medical Center, and public library; and in Richland, the Joint Center for Graduate Study, public schools, and city library. This proposal was not funded.

In 1974, another proposal to HEW was made. Under the title of "A Model Delivery System for Educational and Social Service through Interactive TV" (Harder et al, 1974), this project requested $210,000 to connect the Joint Center for Graduate Study in Richland and the Washington State Penitentiary in Walla Walla with Washington State University in Pullman. This project also went unfunded and unimplemented.

In 1971, Cooperative Extension Service submitted a grant proposal to Exxon Corporation (Nyman, Robins and Searfoss) requesting $29,700 for the development of low-cost telephonic technologies to extend educational resources. This system would have coordinated and consolidated research, extension and instructional activities of the land grant universities in Oregon, Idaho, and Washington utilizing dedicated telephone lines, speaker telephones, and facsimile equipment. This proposal also went unfunded.

On a more modest scale, Washington State University Cooperative Extension has utilized conference telephone calls to link its various off-campus sites to Pullman. These include: the Irrigated Agriculture Research and Extension Center at Prosser, Wa.; Western Washington Research and Extension Center, Puyallup, Wa.; Tree Fruit Research Center, Wenatchee, Wa.; and the Northwestern Washington Research and Extension Unit at Mount Vernon, Washington. Using the Bell Telephone 50A conference call unit, Cooperative Extension has conducted teleconferences, seminars, and classes. Costs for line charges have been reasonable because of a state telephone network called SCAN (State Controlled Area Network, see Appendix E).

The WSU Department of Plant Pathology offered a semester-long seminar to the above locations using the conference call unit. Another department, Foods, Nutrition and Institutional Management, offered telephone courses to the Extension Center in Puyallup. Although written material was sent in advance to these locations, many occasions arose when material was presented spontaneously in the on-campus class in the form of slides or graphic information. The desire was expressed for some means of allowing students at remote sites to see materials being presented in the classroom.

Attempts at establishing instructional communications systems at Washington State University have been disappointing primarily because of the high cost of providing interactive communications systems which included a visual component. A medium which might overcome the problems encountered with other instructional delivery systems is Slow-Scan Television (SSTV).

> The term "Slow-scan television" describes a branch of modern television technology whereby the transmission of high quality pictures from one visual terminal to another takes place at appreciably slower scanning speeds and lower frame rates than are employed in "standard" 525-line systems. For video communications, slow-scan television offers an attractive economic advantage. Because of the slower operating speed, the frequency band containing all the constituents of picture signals is far narrower for slow-scan than the 4.5 megahertz required for standard television. Slow-scan picture signals can therefore be readily accommodated by low capacity transmission media as, for example, telephone lines; unlike standard television, slow-scan needs neither coaxial cable nor microwave facilities, which are expensive to install and difficult to maintain (Hughes Focus, 1976).

The usage of SSTV along with two-way audio by telephone for live interaction appeared to meet the requirement for remote

and extension teaching following the adult and continuing education paradigm while maintaining cost-effectiveness and learning efficacy.

Statement of the Problem

An exhaustive survey of literature disclosed no studies which measured the suitability of the various slow-scan television systems commercially available for instructional use. This study performed that function by comparing four different SSTV systems. The purpose of the study was to measure student reaction to SSTV and to determine which of the four systems was perceived by the students as most desirable for instruction.

Until recently, slow-scan systems have been custom built or adapted from other applications. These systems were designed for teleconferencing and/or surveillance rather than specifically for instruction. This study endeavored to generate data about SSTV's effectiveness in instructional modes in order to help educators select the most effective system currently available. This information was gathered from student evaluators and university faculty who evaluated the systems as "expert witnesses".

A technical evaluation of several available commercial slow-scan television systems was performed in order to determine the systems which matched student preferences. The results may be used as guidelines for a trial SSTV system for university extension teaching, teleconferencing, and remote teaching.

Additionally, suggested specifications were generated regarding development of more effective SSTV systems for instructional applications.

It was hypothesized that an SSTV system with a top-to-bottom scanning system, resolution approximating that of home television, approximately 30 second frame time, and ease of operation would be selected by a subject population of college students as being most suited to instructional usage for remote teaching. A correlary supposition was that faculty would prefer the face-to-face mode of instruction, followed by two-way, interactive television. They would, however, accept SSTV as a viable and effective system for delivery of instructional material.

Scope of the Problem

The scope of the problem consisted of three main areas of investigation. First was an evaluation of commercial, off-the-shelf slow-scan units in terms of electronic parameters, physical characteristics, and cost compiled by the author drawing upon his background as a television engineer, audio-visual specialist and television producer.

Second was an evaluation of the physical characteristics of the image by student evaluators. This was done to see the extent to which the systems transmitted images suitable for instructional purposes.

Third was an evaluation of slow-scan television by selected faculty members and instructors. The "expert witnesses" had viewed a demonstration of the slow-scan process. From these

evaluations came recommendations for suitable usage of this specialized medium for off-campus communication and instruction.

Design of the Study

Systems from various manufacturers have different characteristics, so videotaped examples of visual instructional material were obtained from these suppliers. The visual material in the form of a short instructional lesson was supplied to the manufacturers and the lesson was transmitted through the SSTV process and recorded on videotape. The material, supplied by the author, (see Appendix A) was identical and consisted of an instructional program on the basics of slow-scan television. Visual material consisted of typical instructional media including typewritten lists, line drawings, graphics utilizing rub-down type, continuous tone photos, X-ray radiographs, and high contrast title cards.

SSTV systems have certain resolutions or abilities to show fine detail based upon the number of picture elements which can be stored in electronic memory. Resolution also was one factor in determining frame time, i.e., the time required to construct a new image on the screen. Also SSTV utilized two different methods for displaying a new image. One was a top-to-bottom scan similar to regular television only much slower. The other was a scan made up of vertical lines which constructed a new image from left to right.

Four different slow-scan formats were used: 1. a low resolution, eight second, top-to-bottom scan; 2. a medium

resolution, 35 second, top-to-bottom scan; 3. a medium resolution, 34 second, left-to-right scan; and 4. a high resolution, 78 second, left-to-right scan. The four tapes, which varied from 5 to 12 minutes in length, contained the same visual and aural material and were from two different SSTV manufacturers.

The tapes and questionnaire were first field-tested with a group of Adult and Continuing Education graduate students. The instrument was then modified and the four examples were shown to the following university student groups: freshmen electrical engineering students; engineering graduate students who had exposure to videotaped instruction; and two groups of freshmen speech students. The instrument was designed to assess students' reactions to various parameters such as resolution, frame rate, aspect ratio, direction from which new frames appear, flicker, and overall image quality. Each group of subjects viewed all four tapes in one session. Evaluation was made after each tape was shown. After viewing all four tapes, subjects were asked to supply general demographic data, an overall ranking of the tapes, and suggestions or comments which might help clarify their responses.

The second aspect of the study was the demonstration of a working SSTV system to university professors. The educators had an opportunity to view and evaluate the system and view its effect on graphics which they provided. An individual telephone interview was then conducted on a cross-section of participants. This interview was rather informal but served to

garner input from those "expert witnesses" who would actually be using the system for remote teaching. This interview asked questions related to the ease of operation, advantages or disadvantages of still frames, lack of motion, and image quality. Additionally, any voluntary information was also recorded.

Third was a compilation of technical aspects of not only the four systems tested, but other SSTV systems. Evaluation was made by the author drawing upon his professional skills.

Assumptions

At the outset certain assumptions about slow-scan television were made. These included:

1. Of the currently available commercial SSTV units, some would be more suited to instruction than others;
2. Student evaluator groups would be able to identify the system or systems which offer the most advantages or least disadvantages for instructional purposes;
3. That using the SSTV system most acceptable to students would offer the least impedence to the remote learning process; and
4. Videotaping of the examples would not change the relative quality of the examples.

Limitations

There existed several theoretical as well as practical limitations to the study. First, student evaluators were shown videotaped examples of the various SSTV systems rather than live demonstrations. This was judged not to be a serious limitation since the frequency response or bandwidth of the videotape machines was beyond the resolution limits of the SSTV systems. However, the videotape recording process introduced

certain artifacts into the picture, such as a slight ghosting of vertical edge transitions in the image. This artifact was comparably present on all tapes and would not change the relative quality of the examples.

Second, the examples were videotaped because of logistics and to control variability. They were, of necessity a one-way instructional communication rather than the more preferable two-way system in which SSTV would normally be utilized for adult education.

Third, there were a limited number of groups tested, as well as a limited population. There was not a full permutation of viewing possibilities among the groups. However, the four examples were rotated so that different groups did see different orders of presentation.

Fourth, the evaluation lasted only a short time and only measured subjective responses to the communication medium, not content learned. Lack of available SSTV equipment prevented a longer term evaluation. Although slow-scan television is capable of transmitting color images, the author chose not to enter that variable into the testing because of the increased complexity of testing with that variable and because the literature indicated no significant difference in the effect of color on learning.

A possible limitation was designing an instrument which measured only the effect of the visual component, disregarding other influences.

Expert evaluators were able to see only two of the systems demonstrated. It was believed that this was not a great limitation because they were asked to evaluate a concept rather than discrete systems. However, this limitation could have introduced bias.

And, finally, both groups of evaluators probably had preconceived notions of what "educational television" was about and brought these ideas into their evaluation. The preconceptions were not analyzed in this study.

Definition of Terms

Bandwidth--Amount of frequency spectrum required to transmit information. The bandwidth of a telephone channel is approximately three kilohertz (KHz) while that of a television channel is six megahertz (MHz).

Channel--An electronic pathway for the flow of information, i.e., telephone wires, microwave, satellite.

Controlled Scan Televideo--A phrase coined by Stewart L. Meyer at Northwestern University. Meaning the same as the generic slow-scan television (see below), it is more descriptive of the potential and various configurations of SSTV.

Facsimile--A process and/or device for transmission of printed material by electronic means.

Frame--One complete television image made up of many horizontal scan lines. In standard television a frame is sent every 1/30 of a second. SSTV may have frame rates from a few seconds to a few minutes.

Kilohertz (KHz)--A measurement of frequency. A hertz is one cycle per second. One KHz equals 1,000 cycles per second.

Megahertz (MHz)--One million cycles per second. Also, 1,000 KHz.

Remote Teaching--Descriptive of situations where teacher and learner are physically separated. Examples are correspondence courses, videotaped lectures, telephone and two-way telephone lectures or seminars.

Resolution--A measure of the ability of a visual system (film, television, facsimile) to display fine detail in the observed image.

Scan--A television image is assembled by serially displaying individual picture elements. Standard television assembles the image with horizontal lines which start at the top of the picture and move to the bottom. Some SSTV scan systems work like standard television only much slower. This is a top-to-bottom scan. Some SSTV systems assemble an image with vertical lines which start building a new image at the left side of the screen and move to the right, thus a left-to-right scan.

Slow-Scan Television (SSTV)--A method of transmitting a television image by slowing down the scan time required to assemble a frame of information. This results in a reduced bandwidth inversely proportional to the frame time.

Standard Television--A system where horizontal scan lines scan the face of the picture tube at the rate of approximately 15 KHz making up a frame consisting of 525 lines with a duration of 1/30 of a second. This rapid frame rate allows for motion

but is very redundant, especially when reproducing still images. It also requires large bandwidth.

Teleconferencing--The exchange of information and data via electronic media in a conference setting involving multiple participants at two or more locations. It is intended to approximate, or to serve as an alternative for, direct face-to-face interaction (Hubbard, 1977).

Two-way, Interactive Television--A specialized television system in which video and audio travel from distant points in both directions. It is used in teleconferencing and teaching. Since it is two-way, students at a remote location can see and hear the teacher and the teacher can likewise see and hear the students. It is live and closely simulates face-to-face interaction.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

Available literature pertaining to the application of SSTV in instructional usage was exceedingly sparse. In addition to actual research in SSTV, literature regarding other aspects of educational technology was consulted. The literature review examined areas such as educational implications of motion versus non-motion, color versus monochrome and the hierarchy of interaction in educational media. Research pertaining to the utilization of SSTV was carefully examined and the field of teleconferencing was explored.

Motion Versus Non-motion

Due to the lack of motion in a slow-scan system, the literature was examined to see what was indicated regarding motion in instructional media. Early writings discussed comparison of motion pictures versus filmstrips and slides. Hoban and van Ormer (1950) examined previous research on motion picture effects for the Navy and summarized the works of McCluskey and McCluskey, Carson, and Hovland, Lumsdaine and Sheffield. In 1924, McClusky and McClusky compared two different motion pictures with slides of the same material and found that slides plus sub-titles with oral comments taught the subject matter equally as well as the motion pictures.

Carson in 1947 compared a sound motion picture, a 102 frame filmstrip, and on the assumption that the original filmstrip was too long, an abbreviated filmstrip. A forty item test was administered to subjects after viewing respective presentations and results showed a mean knowledge gain for all versions as compared to a control group. The full filmstrip was superior to the abbreviated version and both filmstrips were superior to the motion picture in informational and conceptual learning.

In 1949, Hovland, Lumsdaine, and Sheffield compared the effectiveness of a 43 minute Army training film with an Army filmstrip of the same information. Three groups of Army trainees were involved in the test. The control group received no instruction. One group received instruction by filmstrip and the other by use of the motion picture. Results were tested by a 39 item test. In overall scores, there was a slight, but not significant difference, in favor of the group taught by the filmstrip.

With these and other studies Hoban and van Ormer (1950, pp.6-28) formulated the following two postulates based, in part, on research evidence:

1. The "superiority" of the motion picture in achieving the greater comprehension, noted in some comparative studies of motion pictures and filmstrips, usual methods, etc. may result from the greater adaptability of movies for portraying interacting events; and

2. Where filmstrips are found to be "superior" to motion pictures, this superiority may be due to the slower rate of development used in the actual presentation of the filmstrip to the audience.

In 1967, Chu and Schramm (1968) evaluated further research on the question of motion. They found that Lasser (1955) compared the effectiveness of a film and filmstrip having identical commentaries in teaching a manipulative task. No significant difference was found on overall performance of the filmstrip group compared with that of the film group. When the task was analyzed step by step it was found that the film group did better in one step where continuity of action played an essential part.

In an experiment by Beach (1960), no difference in learning was found between a group that viewed a televison news program in motion pictures and a group that saw an identical news presentation with still pictures only. Chu and Schramm (1968) stated, "What these experiments suggest is that moving visual images do not add significantly more to learning than still visual images do, unless the continuity of action is an essential part of the learning task, as Lasser has found. Otherwise, students will learn as well from still visuals as from moving visual images" (p.95). This was essentially what Hoban and van Ormer wrote in their first postulate.

Color Versus Black and White

From a review of literature by Chu and Schramm (1968) it appeared that the use of color in film or television does not significantly improve learning.

> However, while saying that color does not seem to improve learning in general, we must not overlook the possibility that in certain particular learning tasks, color may play an essential part. For instance, certain substances, like

> blood, have no definite shape and can only be identified by color. A black and white presentation would therefore be greatly handicapped. Or, sometimes color will be necessary to make a particular object stand out in order to be recognized. In these situations, a color presentation will be necessary. Otherwise, the cost factor would favor the black-and-white version (p.25).

Media Hierarchy

Cohen and Meyer (1975) contended that the paradigm of a teacher using a chalkboard or overhead projector indicated the lack of motion inherent in most class situations. They noted the importance of interaction between participants in a teaching-learning situation stating, "It is this interaction which transfers the mere transfer of information into the process of instruction" (p.174). Through empirical observation they devised the following list of educational situations in decreasing order of student-teacher interactions:

1. Tutorials
2. Traditional classroom
3. Instructional television--motion-television (broadcast or cable) with audio response from students (via telephone or radio)
4. SSTV with audio response
5. Two-way audio only (via telephone or radio)
6. Two-way audio combined with slides, films, film loops, etc.
7. Computer Assisted Instruction (CAI)
8. Motion-television only (educational TV) with no feedback from students
9. Correspondence courses, programmed texts, slide-tape lectures
10. Texts
11. Audio cassette or radio only (p.175)

Slow-Scan Research

Slow scan television has been utilized for some time in the instructional arena although the earlier technologies made

some of the installations rather unreliable and they have fallen into disuse. One of the pioneering applications of the SSTV technology to instruction was that of Colorado State University (Southworth, 1969). A program called CO-TIE (Co-operation via Televised Instruction in Education) tied CSU with four junior colleges in the state via telephone lines. The major purpose was to augment pre-engineering curriculum at the junior colleges. Students were instructed by a system which used one-way SSTV and two-way audio, thus allowing student-teacher interaction. The system employed a Colorado Video, Incorporated unit with a 50 second frame time.

One of the older SSTV systems in the United States was operated by the South Bend Community School Corporation in South Bend, Indiana. In 1972, the corporation received approval from the Federal Communications Commission to experiment with SSTV transmission over FM radio sub-carrier.

Hardware was provided by Colorado Video, Incorporated. Because of the approximately 8 kilohertz bandwidth inherent in the radio sub-carrier, frame time for this system was 10 seconds. Resolution was about 200 TV lines and the system was capable of seven shades of gray.

Early tests were conducted with a reading program series which was broadcast to second and third graders. A survey of these students was conducted after completion of the series. A portion of the responses follow:

	Yes	No
Did you like the slow-scan TV pictures?	246	66
Is slow-scan TV interesting?	220	98
Is it fun to watch slow-scan TV?	218	89

	Yes	No
Are the programs easy to follow?	253	58
Is it easy to learn from slow-scan TV?	283	26
Do the slow-scan TV pictures move?	126	183

The programs tested were consonant and vowel discrimination and identification for second and third grades. "These were presented the second semester and consequently were review. The test data was [sic] inconclusive (Project Stimulus Brochure).

Another working slow-scan system was that of the Copper County Intermediate School District located on Michigan's Upper Peninsula. In one experiment SSTV was used for in-service teacher education (Baker and Cory, 1977). SSTV programs on Competency Based Education were shown to district teachers. The sequence consisted of a pre-test, learning activities which included the SSTV programs and learning packets, and a post-test. Post-testing showed a mean increase in knowledge. Changes in attitude toward competency based education did not show a mean increase. However, attitudinal pre-test scores were all well above 4.00 on a 5 point scale (5=very positive attitude).

The process of transmission for this test involved sending slow-scan images by telephone lines to regional cable television companies. The cable operators then converted the images back to standard television signals for distribution to anyone on their cable systems. The programs were broadcast four times a week to meet the schedules of participating educators. Limitations of the project were that only those persons with access to cable television could receive the programming. Additionally, since these programs were recorded on videotape, there was no immediate facilitator-participant interaction.

Facilitators and participants met together later in the week after viewing the programs for a feedback session. The SSTV system utilized was a Colorado Video, Incorporated, system with a ten second frame time and left-to-right image display.

Professionals in the health sciences have continued to show an interest in the use of slow-scan television. Since many medical test results are static in nature, i.e. radiographs, radio isotope scans, gamma scintigrams, electrocardiograms, electroencephalograms, etc., it is not necessary to utilize real-time television in the transmission of this kind of information for consultation or teaching.

One test of this premise was the use of SSTV for transmission of nuclear images (Corbus and Webber, 1972). Ninety scintillation scan examinations were transmitted. The image was interpreted by a physician and recorded. Later, the films were directly viewed and the results interpreted and recorded. The results of the SSTV interpretations and the direct viewing interpretations were compared and tabulated. Categories were: positive for pathology; negative for pathology; or equivocal. The transmission time for the SSTV tests was 100 seconds with X-ray films making up the bulk of the transmissions.

Results showed 68 of the 90 examinations were the same for SSTV evaluation and direct view evaluation. Tabulation of results appears below:

	SSTV by phone line	Direct
Positive	32	32
Negative	36	48
Equivocal	19	10
Technically inadequate	3	0
Total	90	90

> The system was found to have potential for future applications in bringing nuclear medicine services to small, remote hospitals. The results of this study indicated that no positive examinations were misread. However, there was a tendency for television interpretation to be equivocal or positive when direct interpretation was negative (Corbus and Webber, 1972, p.381).

In another test of radiographic images (Jelass, Purcell, and Southworth, 1978) SSTV reports were requested for a range of primarily chest and skeletal radiographs. When interpretation was in doubt, the films were dispatched to the hospital for direct reading. All cases reported by SSTV were later checked directly for final interpretation.

Of 290 cases, 82% were interpreted without any discrepancy from the final reading. Counting deferred diagnosis readings and even the slightest discrepancy as an error, 18% of the cases were SSTV failures. Fifty-four percent of the SSTV failures were false negative, 27% were false positive, while 19% were diagnosis deferred. Of the deferred diagnosis readings, the initial report accurately reflected the conclusions drawn from direct interpretation of the radiographs.

A Colorado Video, Inc. (CVI) Model 201A scan converter and a CVI model 275 video expander were used for the experiment. Resolution of the system was approximately 125,000 picture elements. The authors stated,

> This system could be applied in hospital-home linkages, between community and university hospitals to permit specialty consultation, or for teaching purposes. The equipment is capable of sending electroencephalograms, electrocardiograms, and other graphic record by reflected light as well as radiographs (p.49).

To the writer's knowledge, the number of experiments which generated any hard data on SSTV usage for instruction were very

limited. The following examples appeared to be the prime studies. The first experiment encountered was Project Tele-prof (George, 1976). This project was basically a test of a possible remote teaching system between two Canadian military colleges. The communication link between the two locations consisted of the combination of a voice switching audio system, a slow-scan video unit, an alpha-numeric data storage/retrieval device and a facsimile unit. The system was tested in two remote teaching conditions. Condition 1 was the combination of tele-teaching and face-to-face teaching where the lecturer addressed simultaneously a remote group and a local class. Condition 2 involved a remote group only. Evaluations were made of both technical feasibility and student behavior and attitude.

Because of the limitations of the trial, extended conclusions could not be drawn. However, the evaluators noted that Condition 1 remote students tended to demonstrate a lower level of participation in comparison with the other remote group (Condition 2). It was also observed that the teacher employed, alternately, two teaching styles while lecturing in Condition 1--a traditional lecture delivery style and a mediated teaching style. The results of the attitude questionnaire administered to the students showed an overall slight trend toward increasing acceptance of the system after a week-long trial.

In comparision with other media, SSTV was rated high in rigidity or inflexibility, medium in preparation time for effective use, high in delivery time, high in cost, and high in operational complexity. The study investigated the possibility of having SSTV in individual homes and concluded, "if only

schools and similar institutions have receiving devices (SSTV), rather than every home, then these devices can be expensive but, transmission costs can be reduced by 99.9% by using an audio (i.e. telephone) rather than video channel" (George, 1976, p.3).

Cohen and Meyer (1975) experimented with SSTV in 1974. Each professor taught one class per week to a group located in another building on the Northwestern University campus. These authors indicated that the test was more artificial than either would have liked because the student groups consisted of full-time students who had the opportunity for live interaction with the instructors and there was no educational necessity for the students to have been taught in this way. Evaluation of the test indicated that:

1. The thirty second frame rate of this particular slow-scan system (RCA) was accepted by the students; and
2. Learning and acceptance of the information by the students increased as the level of student-instructor interaction increased.

Meyer (1977), made a second test of the SSTV system. This test consisted of a four week experiment in which a course was taught to students at Motorola's Research Center about 25 miles from campus. A technical change was made from the first experiment. Two video monitors were employed. The last frame of video was retained on one monitor while new information was being scanned onto the second. "During the last session a crude student 'evaluation' was done" (p.5). The results of this evaluation were:

1. More than 80% of the students felt that they had learned as much in the SSTV lectures as they would have in the same amount of time spent in a live lecture;

2. Ninety percent strongly preferred being able to stay in the plant to take a course;

3. Over 70% thought the last video frame retention feature was an important addition;

4. Ninety percent of the class was satisfied with the fidelity of the telephone audio;

5. Ninety percent said that the video picture helped to direct and focus their attention for enhanced learning even when the picture was not absolutely essential for the presentation. Video tapes of the remote classroom situation show students asking questions of the (still) monitor as if it were the professor;

6. Sixty percent would pay tuition money themselves to receive courses by this medium;

7. The members of the class were split as to whether they thought motion was necessary. It is thought that this was not due to the demands of the course but, rather, to the erroneous preconception of the class that they would be seeing Closed Circuit TV (CCTV); and

8. The class was not entirely comfortable with SSTV. About half said they "didn't like it" but couldn't pinpoint why.

Teleconferencing

The application of SSTV technology to teleconferencing has potential for University extension work as well as other university administrative uses. As Samuel Hubbard (1977) of the National Aeronautics and Space Administration, NASA, indicated,

> Teleconferencing is a particularly important new use of communications since it could generate significant savings in travel time and cost, energy consumption, response time and organizational efficiency. The energy savings dividend, alone, provided sufficient justification for the widespread use of teleconferencing in a world facing a major petroleum shortage within the next ten to fifteen-year period (p.42).

Voice communication between teleconferencing terminals can be augmented at the expense of bandwidth with facsimile or slow-scan video. Placed along a continuum describing teleconferencing systems in terms of their signal transmission capacities, the next most complicated system, then, would be an audio network supplemented with various still-visual transmission techniques (Casey-Stahmer and Havron, 1973).

As the concepts and technology of teleconferencing advanced, Johansen (cited in Parker and Riccomini, 1976, pp.122-127) warned of pitfalls in the social evaluation of teleconferencing media.

> Pitfall #1. The standards of face-to-face communication should not be the sole basis for evaluation of teleconferencing.

"Research to date suggests that an audio channel is quite adequate for many tasks and that the full video picture may not always add to the quality of the meeting" (p.122). Comparison by Casey-Stahmer and Havron (1973) indicated that the advantages of full video were incremental, while the increase in cost was very large. Less expensive systems such as SSTV or fascimile often provided the necessary adjuncts to an audio-only system.

> Pitfall #2. It is always difficult and often impossible to distinguish among effects related to communications medium, group task, group dynamics, and personality factors.
>
> Pitfall #3. Laboratory methods have only limited application in the evaluation of teleconferencing media.
>
> Pitfall #4. Initial uses of teleconferencing systems often serve as a poor basis for generalizing about future uses.

Since video teleconferencing has the outward look of television networking and programming, much of the expectations and jargon from commercial television were transferred to the newer medium.

> Pitfall #5. While field test questionnaires can be improved by using questions applicable to several media there is little hope for a "universal" questionnaire.

While a standardized questionnaire was appealing it became too broad and too long to be usable.

Summary

From the literature it appeared that motion pictures or real-time television offered no significant learning advantage over still pictures except in the case where continuity of action is an essential part of the learning task. Color appeared not to improve learning except in some very specialized cases. Slow-scan television had been used for some time in the instructional milieu but few experiments had been conducted to test its effectiveness as an instructional tool. Experiments appeared to lack academic rigor. And, those tests had not apparently solicited input from student subjects as to the optimal design of SSTV systems.

The health sciences have conducted some rigorous tests on the suitability of SSTV systems as long-distance diagnostic tools. Those tests yielded varying degrees of success in transmitting X-rays and other diagnostic data. The specialized nature of the medical information transmitted allowed little generalization of results into the instructional arena. Finally, data from experimentation with teleconferencing indicated that

SSTV might very well be utilized with effectiveness and attendant cost savings. This research also warned against measurement of new media using old criteria and expectations.

The above studies appeared to be the prime experiments which had been attempted on the SSTV medium. A compendium of educational telecommunications (Wood and Wylie, 1977) included only one paragraph on SSTV. It concluded with the statement that, ". . . the instructional advantage of being able to transmit a still video picture every 10 seconds has many intriguing educational applications."

If the "instruments" and evaluative techniques of the previously mentioned studies indicated a benchmark of activity in this field it appeared that the field was quite open to research in SSTV and other limited bandwidth communications media as related to their application in instruction.

CHAPTER 3

DESIGN OF THE STUDY

Introduction

Testing and evaluation of the slow-scan television medium consisted of three parts: 1. Equipment evaluation of the physical, electrical and cost variables of commercially available SSTV systems; 2. An experiment in which university students were asked to give subjective reactions to four different slow-scan systems in an attempt to determine which system was more suited to transmission of instructional materials; and 3. An informal evaluation [by selected university faculty members] of the concepts and applications of SSTV as an instructional medium for remote teaching.

Equipment Evaluation

Data were obtained from four different manufacturers of SSTV equipment. This information was compiled into tabular form for comparison of cost, frame time, direction of scan, and gray-scale. Compilation of technical specifications in tabular format allowed the author to evaluate the advantages and disadvantages of the various systems for the purpose of selecting the more appropriate system for instructional usage. Additional data gathered pertained to cost factors involved in transmitting

slow-scan images over telephone lines as compared to transmitting real-time television over microwave circuits.

Experimental Evaluation

The literature revealed no attempt to measure student reaction to available slow-scan systems. Experiments had been conducted which attempted to measure learning and the results demonstrated success. These experiments all used only one SSTV system and made no attempt to measure reactions to the variables contained in differing SSTV systems.

The author exposed university students to a cross-section of available SSTV systems, documenting student preference for a specific system or systems.

It would have been desirable to expose students to direct viewing from various slow-scan systems. This proved to be impossible from a logistical point. A practical solution lay in video-taping examples of four different slow-scan systems. The video-tape medium was not a completely transparent carrier of the SSTV image as it introduced an artifact in the form of ringing or a slight "ghost" on the right edge of vertical lines. It introduced this artifact to the same relative degree on all examples. It was judged that the videotape recorder had sufficient bandwidth (300 lines) to not affect the resolution of the images.

Conditions of slow-scan performance which the author assessed through student evaluation were:

1. Clarity of display of written and graphic information;
2. The degree to which photographic detail was transmitted;
3. Overall image resolution;
4. Variations in the time required for a new image to appear;
5. The way in which a new image appeared on the screen, i.e., top-to-bottom or left-to-right;
6. Image shape--square or rectangular (also known as aspect ratio--height/width);
7. How well audio and visual components correlated; and
8. Image flicker.

These conditions followed, to some degree, the technical parameters of slow-scan television which were tabulated earlier. The first three conditions related to resolution. The examination of photographic detail related to gray-scale as well. Frame time considerations made up condition 4. Conditions 5, 6, and 8 related to psychological considerations and learner perception. Condition 7 attempted to measure efficiency of the system as related to learning. A high correlation would indicate high efficiency while a low correlation would indicate the need for redundency in design of learning material as a constraint of the system.

It should be noted that the parameters or conditions were compared against each other rather than an absolute standard. Johansen (cited in Parker and Riccomini, 1976, pp.122-127) cautioned against measuring new media using old criteria and expectations. If one were to use an absolute reference it would most probably be broadcast television technical standards as published by the Federal Communications Commission.

To determine reaction to the various slow-scan systems, a short video instructional program on the topic of "Controlled Scan Televideo," a term coined by Meyer (1977) to describe

slow-scan television, was produced. Keeping the eight conditions in mind, ten visuals were designed along with a corresponding script (see Appendix A). The visuals consisted of a title which had white press-type lettering on a black background, graphics with black-on-white, typed factual information, a photograph, an X-ray radiograph, and a freeze-frame from a closed-circuit television camera. The photograph and one graphic were designed to have been scanned from left to right, while two typewritten visuals were designed for top-to-bottom scanning. The remainder of the visuals were neutral with respect to scan direction. The individual videotapes were prepared using identical visuals. The audio portion of the program consisted of a tape recorded narration so that an identical message was transferred to the audio track of each videotape. The time of the audio message varied from tape to tape so as to match the visual display.

A questionnaire was designed to assess reaction to the varying aspects of SSTV. The dependent variables measured were the physical and electrical characteristics of the videotaped examples as indicated in the above conditions (See Appendix B).

The four tapes had varying conditions of performance. Tape 1 featured a low resolution system in which the image was made up of distinct little squares which gave diagonal lines a "sawtooth" appearance. Tapes 2 and 3 were of medium resolution with an image approximating the quality of broadcast television as seen on an average home receiver. Tape 4 was a high resolution system which approximated a broadcast picture before transmission through a TV transmitter. Tapes 1 and 3 had

scanning which was made up of horizontal lines which built from the top of the screen to the bottom over the previous image. Tapes 2 and 4 scanned with vertical lines which came from the left side of the screen and "wrote" a new picture over the previous one.

The technical details of the four tapes were:

Tape 1. The Robot Research Model 530 transceiver. This was a low resolution system which utilized a square image (1:1 aspect ratio) with top-to-bottom scanning. Resolution was 128 horizontal picture elements by 128 vertical elements with 16 levels of gray. Frame time was 8.5 seconds.

Tape 2. The Colorado Video, Incorporated Model 260B transmitter (compressor) and Model 275A receiver (expander). This system was a medium resolution and had 256 horizontal picture elements by 256 vertical elements with 64 levels of gray. The image shape was rectangular (3:4 aspect ratio) with left-to-right scanning and a frame time of 34 seconds.

Tape 3. The Robot Research Model 630 medium resolution transceiver. Resolution was 256 horizontal picture elements by 256 vertical elements with 64 levels of gray. This system featured a rectangular image (3:4 aspect ratio) with top-to-bottom scanning and 35 second frame time.

Tape 4. The Colorado Video, Incorporated Model 260B transmitter (compressor) and Model 275B receiver (expander). This high resolution system had 512 horizontal picture elements by 256 vertical elements with 64 levels of gray. Image aspect ratio was 3:4 (rectangular) featuring left-to-right scanning and a frame time of 78 seconds.

As a field test of the presentation tapes and the instrument, tapes 1, 2, and 4 were shown to a class of Adult and Continuing Education graduate students. After reviewing the questionnaire responses and comments received, two questionnaire items were revised (see Appendix C). One was split into two questions while the other was reworded to help clarify its meaning. A third item, relating to flicker, was deleted. Question eight on the original questionnaire asked students to respond to image flicker and results indicated non-discrimination with responses falling across the entire scale. Apparently, students were responding to picture abberations other than flicker. Another explanation might have been the variance in the critical flicker fusion factor among individuals. The question was discarded rather than rewritten because the flicker, which is characteristic of tape 4 only, is an integral part of high resolution systems and as such, cannot easily be reduced. It results from television field one interacting with field two.

It was also determined from the pre-test that shorter examples would have adequately tested the response to SSTV with reduced viewer fatigue. Unfortunately, it was not possible to shorten the examples without causing distracting visual discontinuities in the slow-scan display. Editing would have caused direct "cuts" or image changes without the characteristic picture build up of SSTV. However, because of its extreme length (13 minutes), tape 4 was edited to approximately nine minutes.

After redesign of the instrument, the presentations were administered to four test groups. The groups were: a graduate

electrical engineering class in which subjects had had experience with videotaped courses; two sections of Speech 101 in which most subjects were freshmen; and a freshman Electrical Engineering 110 class.

Each group viewed all four videotaped examples consecutively in one class period. Approximately 45 minutes were required to view the four tapes and respond on the questionnaire. The author desired to minimize the effect of order on the responses. Ideally, the order of presentations should have been permutated by 4! or 24 times. This experiment was constrained by time limitations to rotating the order of presentation among the four groups.

Group A viewed a presentation order of tapes 1,2,3,4.
Group B viewed a presentation order of tapes 4,1,2,3.
Group C viewed a presentation order of tapes 3,4,1,2.
Group D viewed a presentation order of tapes 2,3,4,1.

As mentioned, example 4 was edited into a shorter version for groups A, C, and D. It was explained to these groups that the tape had been edited in order to save time. Key visuals which pertained to order of scan, resolution and gray scale were retained. Group B received the full-length version of tape 4 because it was viewed first. There was concern that the edited version might have led to confusion had it been viewed first.

The video presentations were recorded on 3/4 inch U-format videocassettes and were displayed on a Sony 19 inch black and white monitor. The video player was a Panasonic Model NV 2110M. The same player and monitor were used for all presentations. Viewer distance from the monitor was requested on the questionnaire.

The presentations were made in standard university classrooms. Three of the four presentations took place in the same room. Viewing took place with overhead fluorescent lighting extinguished but with enough ambient room light for reading questionnaires.

Faculty Evaluation

A limited number of university professors attended demonstrations of either the Colorado Video, Incorporated or the Robot Research SSTV system. Only one viewed both. The demonstrations consisted of allowing instructors to work with the units and test various written and graphic visuals in the system. Additionally, they viewed demonstrations of the systems with material being sent over ordinary phone lines from Boulder, Colorado and San Diego, California, respectively. Since lead time for setting up these demonstrations was extremely short, there was not time to develop an instrument to measure attitudes and opinions of the instructional groups toward SSTV. At a later time, from one to three months after exposure, the author informally interviewed six of the professors who had seen the demonstrations. The instructors were encouraged to discuss their reactions to SSTV, the disadvantages, advantages, and possible applications for their areas.

The areas which those professors represented were: Speech, Rhetoric and Communications Studies; Communications; Women's Physical Education; College of Veterinary Medicine, Biomedical Communications; Cooperative Extension; and Office of Continuing University Studies.

CHAPTER 4

ANALYSIS OF THE DATA

Introduction

In this chapter hard data from the SSTV evaluation experiment were subjected to scientific analysis. Information from various manufacturers was collated and examined. Tariff data on telephone and microwave circuit cost comparison, obtained from General Telephone of the Northwest, the common carrier which serves Pullman and Washington State University, were presented. Information from telephonic interviews with faculty members who had seen an SSTV demonstration was also compiled and evaluated.

Experimental Data

A total of 73 subjects were tested. Group A had 11 subjects, Group B had 20, Group C had 22, and Group D had 20 subjects. Since the rotation of presentation sequence across the four groups tended to neutralize the effects of order, responses from the four groups were summed for each tape. Student subjects responded to questions 1 through 8 on a 5 point scale. After testing was completed a numerical value from 1 to 5 was superimposed upon the scale. Five indicated a positive response while one reflected a negative response.

Mid-points were also superimposed. Responses were allowed on any point on the scale. In evaluating the data, responses which were grouped about a point were assigned that value. For instance, responses from 1.5 to 2.5 were assigned the value 2. Values between 1 and 1.5 were assigned the value 1 and responses between 4.5 and 5 were assigned the value 5. A mean of the responses was calculated for each question with respect to each of the four tapes.

Since tapes 1 and 3 featured a top-to-bottom scan and tapes 2 and 4 featured a left-to-right scan, responses to question 6 were summed for tapes 1 and 3 and the mean compared to the mean for the summation of responses for tapes 2 and 4. Results appear in Table 1.

Table 1

Mean Values of Responses to Four Videotaped Presentations (N=73)

Questions	Tapes					
	1	2	3	4	1+3/2	2+4/2
1. Written readability	1.75	4.12	3.64	3.79		
2. Graphic readability	2.31	4.00	3.77	3.79		
3. Photographic detail	2.15	3.82	3.47	3.67		
4. Overall resolution	1.76	3.64	3.38	3.41		
5. Frame time	2.91	2.19	2.27	1.79		
6. Direction of scan	3.08	2.60	2.95	2.33	3.02	2.47
7. Correlation-sound/picture	3.58	3.65	3.70	3.47		
8. Shape	2.55	3.55	3.44	3.44		

Significance of the difference between means was determined using a t test for correlated samples. The independent variables were the four videotaped SSTV examples and the dependent variables were the subject ratings of the videotaped examples. Table 2 indicates the difference in means for paired samples and the degree of significance.

Table 2

Differences of Means among Videotaped Presentations

Questions	Tape Pairs					
	1-2	1-3	1-4	2-3	2-4	3-4
1	-2.37*	-1.89*	-2.04*	0.48*	0.33*	-0.15
2	-1.69*	-1.46*	-1.48*	0.23*	0.21	-0.02
3	-1.67*	-1.32*	-1.52*	0.35*	0.15	-0.20*
4	-1.88*	-1.62*	-1.65*	0.26*	0.23*	-0.03
5	0.72*	0.64*	1.12*	-0.08	0.40*	0.48*
6	0.48*	0.13	0.75*	-0.35*	0.27*	0.62*
7	-0.07	-0.12	0.11	-0.05	0.18	0.23*
8	-1.00*	-0.89*	-0.89*	0.11	0.11	0.00

*p<.01

Note: A substantial number of differences of means were subjected to t tests. Differences above 0.48 were not tested.

After completing questions for each taped example, students were asked to rank the tapes from one to four with one being the best and four being the poorest. Some students did not follow directions and rated the presentations rather than ranking them. Some numbers were used more than once resulting in tied ranks. In these cases the responses were assigned the average rank which the tied responses occupied.

The results were tested for significance by the Friedman (cited in Ferguson, 1976, p.394) two-way analysis of variance by ranks. The test works for any number of correlated samples. The result has an approximate chi-square distribution. The resultant chi-square value of 82.53 had a probability of $p<.001$. Therefore, the mean differences were significant. The overall rankings of the tapes appear in Table 3.

Table 3

Student Ranking of SSTV Videotaped Examples

Tapes	Systems	Ranks
1	Robot Model 530	4
2	CVI Model 275A	2
3	Robot Model 630	1
4	CVI Model 275B	3

Faculty Input

Information was gathered by telephone interviews from selected faculty members who had seen a demonstration of slow-scan television. Comments from these individuals were helpful in clarifying thinking about applications and limitations of SSTV. Below are some of the comments from this group.

A professor of Speech and Communications Disorders attended the demonstration hoping to find a system which could be used to supervise speech clinicians in the field. He found the lack of motion and long frame time to be a major handicap. He found the temporal delay of SSTV "bothersome" for his application. However, for other uses he felt the process of display building was a positive, attention-getting feature.

Another professor, from the Physical Education department, had taught extension courses by amplified telephone and videotape. She felt the addition of SSTV to her telephone lectures and question and answer sessions would have aided transmission of knowledge and understanding. She felt SSTV was an extemporaneous medium for immediate feedback. With prior planning, visual materials could be mailed to remote sites ahead of scheduled sessions, thereby eliminating the need for SSTV in teleconferences. She indicated that facsimile might serve her needs equally as well as SSTV. She rated the effectiveness of SSTV between telephone lectures and two-way television.

A professor of Communications brought up the point of bringing expertise to campus by means of SSTV, rather than exporting it. His need was to keep his students appraised of current practices in broadcasting. He felt the visual component of SSTV would be adequate for supplementing amplified telephone interviews with industry leaders.

A journalist with Cooperative Extension saw an application of SSTV in administrative teleconferencing with other extension units around the state.

A program specialist for the Office of Continuing University Studies said she saw no immediate application to any current off-campus classes because none were being taught live. All were offered by videotape or correspondence. She felt that information presented by SSTV was too temporary and that handouts better served her purposes. She equated material transmitted on SSTV with that of overhead transparencies in the traditional

classroom. She felt facsimile was better suited to her needs. The disadvantages of SSTV outweighed the advantages. She cited high capital cost and operator/personnel costs as the main disadvantages. As an interesting application of SSTV, she thought it would be very useful for extremely remote sites such as students on shipboard.

A Veterinary Biomedical Communications director was the only person who saw both the CVI and Robot demonstrations. Her reactions were that the CVI unit had better resolution but that the Robot unit was more cost effective and easier for the neophyte instructor to use. She saw immediate application for SSTV in her area in remote teaching as well as administrative teleconferencing and continuing education of working professionals. She also indicated another application might be that of remote diagnosis by SSTV transmitted X-rays or actual live images of animals.

Equipment Evaluation

Analysis of technical data consisted of tabulating information provided by the various manufacturers of slow-scan equipment. Tariff data on telephone and microwave circuits were obtained from General Telephone of the Northwest, the common carrier which serves Pullman and Washington State University. That information was also tabulated and these data appear in Appendices D and E.

After evaluating equipment specifications from manufacturers of slow-scan systems, it appeared that the Robot Model 630 offered the most cost-effective system. It featured a 35

second frame time, top-to-bottom display, adequate resolution and gray scale, plus ease of operation. Another promising system was the Data Systems 706. This unit used the same transmission technique as the Robot, and could transmit to, but not receive from the Robot 630.

In addition, it contained two memories so that information could be transmitted to the receiver site without the audience seeing the slow-scan image build on the screen. At the appropriate time, the new information is switched on instantaneously from the transmit location. The system could also be used with two video monitors to show two frames of information simultaneously. Meyer (1977) found this latter feature highly desirable.

Nippon Electric Corporation (NEC) of America made a color SSTV system and had as an option a real-time pointer which the instructor could move about an already transmitted image.

Colorado Video, Inc., offered high resolution units for those who needed this feature such as those in the medical communications areas. Units could be custom built to any specification.

Transmission Costs

Costs for various modes of transmission were compiled as indicated in Appendix E. Costs for transmission of SSTV were considerably less than those for real time television. The figures in the appendix were for the picture portion of the message only. If only an occasional picture were sent during the course of an SSTV session, one line could be used for voice communication also. However, if many visuals were to be sent,

an additional voice grade circuit would be needed because the line could not carry SSTV and voice simultaneously.

A dedicated voice grade line offered a cost advantage over direct dial if usage were above 40 hours per month. The State of Washington had a state telephone network (SCAN) which offered considerable savings over regular telephone rates. A dedicated line would have to be used in excess of 137 hours per month in order to show a cost saving over SCAN. SCAN rates were $.07 per minute regardless of distance as long as the call was within the state.

Costs for an 8 kilohertz line were about double those for voice grade circuits. The 8 kilohertz line would, however, allow the use of medium resolution SSTV with frame times on the order of eight to ten seconds.

Costs for video circuits were based upon an initial estimate and may not have been entirely accurate for a finalized system, but they did indicate the order of magnitude of video costs as compared to audio circuits. Additionally, these figures were for one-way video only. Costs would be approximately double for a two-way system.

CHAPTER 5

CONCLUSIONS AND DISCUSSION

Experimental Results

The first eight questions of the assessment instrument pertained to certain characteristics of the four different SSTV systems. Question one assessed the ability of systems to display written information with clarity. Tape 2, the Colorado Video, Inc. (CVI) medium resolution system, scored significantly higher than any other example. This was surprising since tape 4, the CVI high resolution system, had the best overall resolution from a technical standpoint. Tape 3 showed no significant difference compared to tape 4.

Question two asked students to rate how well graphic information was transmitted. Again, tape 2 scored highest while tapes 3 and 4 followed with no significant difference between the two. On question three, which dealt with photographic detail, tapes 2 and 4 were rated best with no significant difference between them. Tape 3 was rated next followed by tape 1. This factor along with questions one and two appeared to indicate that students were not able to discern the higher resolution tape.

In response to question four, students rated tape 2 as having the best overall resolution. Tapes 3 and 4 followed with

no significant difference between them. Tape 1 was judged poorest in resolution.

Question five measured response to frame time. Tape 1 with an 8.5 second frame time was rated "about right." Tapes 2 and 3 with 34 second and 35 second frame times respectively were judged "too long" with no significant difference between the two. Tape 4 with 78 second frame time was rated "much too long."

Question six attempted to ascertain student preference regarding a top-to-bottom or a left-to-right scan. Tapes 1 and 3 which were top-to-bottom scans scored significantly better than tapes 2 and 4.

Question seven dealt with how well sound and picture correlated. Subjects indicated that with tapes 1, 2, and 3 they were "usually" able to correlate narration and image. This was significantly better than tape 4 in which students "sometimes" correlated the two components. It appeared that the longer frame time created problems with matching the information from sound and picture. Question eight indicated that the square picture shape of tape 1 was undesirable while the rectangular image shape of the remaining three tapes was acceptable.

After viewing all of the tape samples, students were asked to rank the tape presentations. Tape 3 was judged to be the best to a significant degree. It was followed by tapes 2, 4, and 1, respectively. Group A, which was composed of graduate engineering students who had had considerable exposure to televised

lectures, ranked tapes 2 and 3 equally. All other groups ranked tape 3 first.

In comparing the first eight questions with the overall ranking, the key factor for overall ranking of the SSTV tapes appeared to be the direction of scan. The systems displayed on tapes 2 and 3 had the same electrical specifications except direction of scan. Tape 2 was rated better or not significantly different from tape 3 on all but question six, which dealt with scan direction, yet tape 3 was ranked higher on overall evaluation.

The student comment section of the questionnaire amplified many of the responses to individual questions including that of scan direction. Eight of the 73 respondents who commented on the scanning system, indicated top-to-bottom was the better scanning system. Several said it was because people read from top to bottom. One subject wrote that either left-to-right or top-to-bottom scanning was acceptable while no one indicated a preference for a left-to-right scan.

Several students expressed a desire for a higher resolution image with the 8.5 second frame time of the lower resolution system. Other students wrote: "All (tapes) were rather distracting but if it saves that much money, you could probably get used to it"; and, "Presentations were OK as long as narration supported the pictures. When there was no narration present I thought the image building took too long." Finally, one student rote, "SSTV is OK if used occasionally but nothing beats the presence of someone instructing you."

It must be noted that tape 3 was at a technical disadvantage as compared to the other three tapes. In order to record a slow-scan image with the Robot 630 unit used for tape 3, it was necessary to first record the signal on audio tape. Then the audio tape was played back through the unit to produce the slow-scan effect for recording on videotape. This caused reduced horizontal resolution and increased noise in the image. The other three tapes were produced by video recording from a camera source directly through the slow-scan units. In spite of this handicap, the Robot Model 630 was ranked highest. Thus, hypothesis one, which stated an SSTV system with a top-to-bottom scanning system would be selected as being most suited to instructional usage for remote teaching, was supported.

During the design of the program material for the videotaped tests, the author encountered a question about using SSTV as a suitable program topic. He decided to keep the topic while trying to minimize bias. After repeated viewing of the program material during testing, the author recognized one area which may have been a possible source of bias. The narration indicated that 30 seconds would be a "typical" frame time for an SSTV system. This could have biased the subjects consciously or unconsciously toward the examples which were 34 and 35 seconds. This is doubtful however, since the data indicated that these frame times were "too long" with 8.5 seconds being the preferred time.

Another problem was that of administering all four tapes to the subjects in one sitting. Many respondents indicated it

was boring to have to sit through four presentations of identical content. It was observed that the subjects paid extremely close attention to the first two presentations and then attention began to wane for the following tapes. The rotation of order of presentation helped insure reliable ratings. The data did not support any out-of-range ratings for examples which were presented later. A retest of the experiment might benefit from using random selection of subjects which would view only one presentation. The problem then becomes "what are the criteria for rating the individual tapes?"

Faculty Evaluation Results

Although faculty members endorsed the concepts of SSTV, all but one could foresee no immediate application of the technology in their respective fields. The supposition was that although SSTV might not have been an instructor's first choice as a remote teaching medium, he/she would accept it as a viable system. The faculty "accepted" SSTV as a concept but, in the author's opinion, failed to accept it in fact, as evidenced by lack of application in their teaching. Thus, the supposition was not supported.

Recommendations for SSTV Systems

Since SSTV technology is currently based around computer memory integrated circuits, it would seem reasonable to expect that prices will continue to decline and/or equipment will become more sophisticated and usable in the academic arena. For instance, Data Systems is working on a microprocessor-controlled

SSTV system which allows mapping of memory for extremely high resolution or reconfiguring that memory to hold up to four frames of low resolution information.

It is the author's belief that SSTV will continue to expand until the time that fiber optics replace copper telephone lines in homes and businesses. At that time, full motion, two-way television will be economically feasible and will become the more desirable medium.

From the combined data, a composite profile of a desirable SSTV system emerged. It would have a resolution of approximately 256 horizontal by 256 vertical picture elements, 64 levels of gray, top-to-bottom scanning and an 8 to 10 second frame time with a real-time pointer. This author, through extensive observation of slide-tape and instructional television programs, believed this feature was extremely important for all SSTV units in instruction. It gave the instructor the ability to efficiently direct learners' attention with minimal verbiage. An additional memory may be helpful. While this hybrid system does not exist, it is entirely feasible to build. The prime concern is that of short frame time while retaining high resolution. In order to meet that combination, an increase in bandwidth over voice grade telephone lines is needed. This may be accomplished by buying an 8 kilohertz line from the phone company or leasing an audio circuit on a satellite. Another method is the use of subcarriers of an FM radio station. This allows the signal to "piggy back" along with the radio signal and be decoded with a special receiver at the remote site.

A remark which appeared in the student comment section was whether a low resolution image could be sent at a fast frame rate for quick reference and be rebuilt at a slower, higher resolution rate. With microprocessor control on an SSTV unit, it could be accomplished.

With educator and manufacturer working together, the technology of slow-scan could serve the ever increasing quest for knowledge and reduce time and travel restraints imposed by the current energy situation.

In the final analysis, one should be mindful that technology is not an end unto itself. The human interaction of adult education remains the prime focus. As Cross and Valley (1974, p.6) wrote, "Those studying the potential of the media are already urging us to think not of what the media will add to education, but rather how new tools of communication will change the entire educational process."

Recommendations for Further Study

For future study it may be desirable to test SSTV systems in an actual remote teaching situation. One aspect of that study could be to analyze the effects of phone lines on the transmission process. Another aspect might be repetition of the experiment upon a remote class to see if present conclusions were supported.

The author desires to test systems under actual conditions not only for student preference but also for the degree of learning. He deems it not necessary to retest all four tapes. It would probably be most helpful to compare tape 2 (Robot) and tape 3 (CVI) against each other and against a control group.

Possibly the control group could be a local class instructed at the same time that remote classes were receiving their instruction.

Another test might be the isolation of one variable from the eight questions and testing it more thoroughly. For example, resolution could be tested in many various subject areas among many student subjects. Likewise, the direction of scan could be tested in several subject areas to determine if some student groups might prefer a left-to-right scan for some subjects. Certainly a color SSTV system could be tested against a comparable black and white system to see if findings from other media, which indicated no difference in learning between color vs. black and white, were supported in SSTV research.

The author was also concerned about the small number of faculty surveyed who had seen an SSTV demonstration. It would be desirable to have a large number of faculty experience SSTV so that a representative sample could be drawn upon to formally evaluate the new medium. It is hoped that research will continue in this field so that educators can make informed selection and use of this branch of educational technology.

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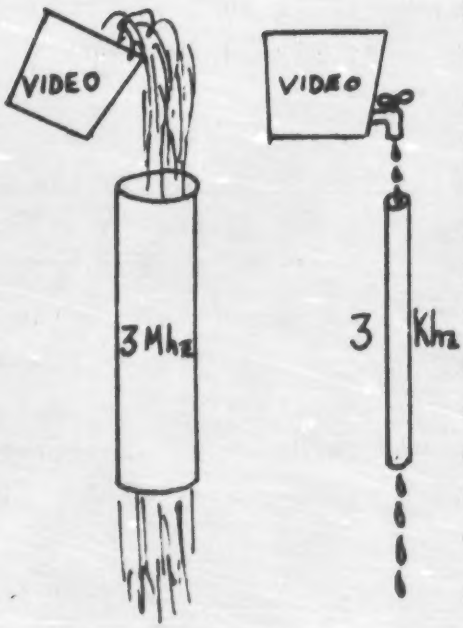
APPENDIX A

SCRIPT OF TEST PROGRAM

FOR STUDENT SUBJECTS

SCRIPT OF TEST PROGRAM

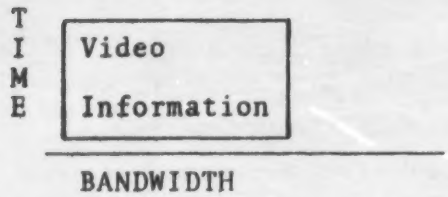
FOR STUDENT SUBJECTS

Video	Audio
1. Presstype white lettering on black, "Controlled Scan Televideo: One aspect of narrow band-width communication."	Controlled Scan Televideo[1]--you may be asking yourself what is it? Possibly you've heard it called Slow-Scan Television. It's a way to send video images or TV pictures over a distance using voice grade communications links like telephone or radio. More expensive microwave or satellite links are now required to send conventional moving television signals over distances.
2. 	Here's an analogy to help explain the basic principles of controlled scan televideo. Buckets of water represent a given amount of video information to be sent and pipelines represent transmission lines. Fast scan or conventional television is similar to dumping a bucket of water into a large diameter pipe. All the water, or all the information appears at the far end almost immediately. The problem is that the large pipe costs a lot. We can move the same

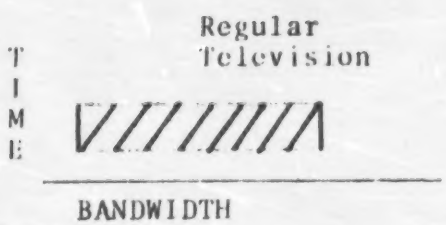
[1]Part of this script adapted from, "Controlled-scan televideo: Efficient utilization of Communications Channels for Teleconferencing and data access," by S. L. Meyer, Northwestern University, 1977.

(2. Cont.) volume of water from the bucket through a small pipe--only it takes longer to accumulate the full bucket at the far end, but, the smaller pipe is much cheaper.

3. A given amount of video information at a certain resolution of sharpness takes up a certain time-bandwidth domain. Bandwidth or frequency spread is measured in a unit called "Hertz." A telephone channel is three kilohertz or 3,000 hertz wide. A microwave channel for video is three megahertz or 3 million hertz wide or wider. Frame time and bandwidth are inversely proportional. As frame time is increased, the picture uses less bandwidth. However, if we increase frame time, we have to give up motion in the picture.



4. Regular fast scan television has a fixed format of one-thirtieth of a second frame time to allow for motion. One must pay the higher price for the large bandwidth needed to transmit fast scan images regardless of whether the feature of motion is needed or not.



5.

With controlled scan televideo, information can be sent in virtually any configuration from fast scan to slow-scan or any point in between. This flexibility allows us to fine tune a system to get the most out of it at the lowest cost consistent with the desired result.

6. Typewritten information:

Fast Scan TV
*525 lines per frame
*30 frames per second
*Allows motion
*Requires 3 Megahertz or more bandwidth
*Satellite or Microwave transmission
*Record on Videotape

Regular or fast scan television images consist of 525 lines of video information which build a new frame or complete picture in 1/30 of a second--or 30 frames every second. This fast frame rate allows the eye to see a display of motion. However, when there is no motion in the picture, the same image continues to be reproduced on the screen 30 times a second. In order to display images at this frame rate--33 million bits of information per second--the system requires a large amount of bandwidth. Sending that information anywhere requires channels such as microwave or satellite which will accommodate three to four megahertz bandwidth.

7. Typewritten information:

Controlled Scan
*Lines per frame--variable, 256 typical
*Frame time--variable, 30 seconds typical
*No Motion
*Bandwidth--in kilohertz range 3 KHz typical
*Telephone or radio transmission
*Can record images on audio tape

If we slow down the scan rate of the television system to say one frame every 30 seconds, the bandwidth required to transmit the signal drops dramatically. The signal can now be transmitted over regular 3 kilohertz telephone lines with the attendant cost savings. We can tailor the system to the resolution required and frame time needed. However, as resolution increases two things may happen: either frame time must increase or bandwidth must increase. At 30 seconds and 3 kilohertz the resolution is about the same as regular television. The system is, however, capable of much higher resolution if needed. An added plus for the system is that once the signal is encoded it may be recorded on audio tape.

8. Continuous tone photograph

Controlled scan tele-video can transmit almost any conceivable image. As shown here it will handle continuous tone images such as from photographs, slides, paintings or half-tone images from publications. Three-dimensional objects may also be shown.

9. X-ray radiograph	Specialized pictorial information from the health science field such as X-ray radiographs, scans from electron microscopes, cardiograms and pictures from microscopes equipped with a television camera may be displayed and transmitted with this system.
10. Freeze-frame of a face	The freeze-frame of the controlled scan system allows virtually any image to be transmitted. This image is from a standard closed-circuit television camera. Existing camera equipment or television studios may be used to originate tele-video. This feature also allows the use of freeze-frame images from existing videotapes. This concludes the demonstration of controlled scan televideo.

APPENDIX B

FIELD TEST QUESTIONNAIRE

CONTROLLED SCAN TELEVIDEO QUESTIONNAIRE

This questionnaire will be used to gain knowledge about the suitability of Controlled Scan Televideo for teaching in situations where teacher and student cannot be in a face-to-face learning environment.

Please place a mark on the scale after each statement which most nearly describes your reaction to that statement.

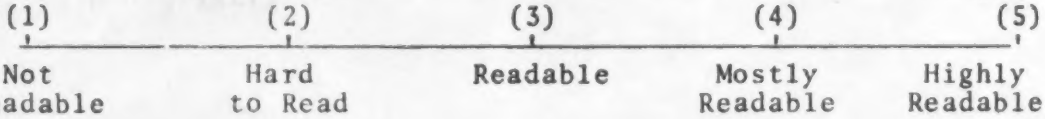
Here is an Example:

The number of hours per week I spend studying is:

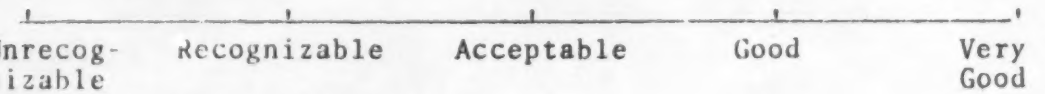
I spend 28 hours per week studying so I checked the point on the scale corresponding to 28.

The following questions numbered 1 through 8 are for your responses to the videotape you have just viewed.

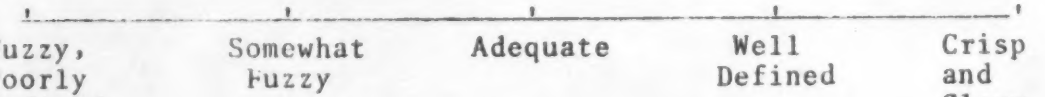
1. The written and graphic information was:



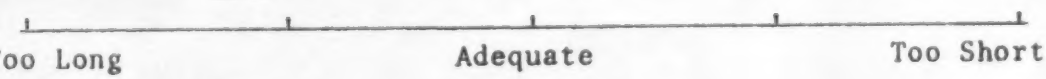
2. The photographic detail was:



3. Overall resolution of the image was:



4. The time required for a new image to appear on the screen was:



5. The manner in which the new image arrives on the screen is:

Highly Distracting	Distracting	Acceptable	Appealing	Highly Appealing

6. Did you correlate the picture with the narration?

Never	Almost Never	Sometimes	Usually	Always

7. The shape of the picture information I viewed was:

Square ( ) Rectangular ( ) [check one]

The shape of the Controlled Scan image was:

Highly Undesirable	Undesirable	Acceptable	Desirable	Highly Desirable

8. Flickering of the image was:

Highly Distracting	Distracting	Acceptable	Slightly Distracting	Not at all Distracting

Additional Information

Year in School _____ Major _____ I.D.# _____

Class in which videotaped examples were viewed _____

Please indicate the type and amount of exposure you have had to instructional television.

Broadcast ITV_____ Videotape_____ Two-way television _____

Other (please specify) _____

Your exposure has been:

None	Slight	Occasional lesson	Series of lessons	Full course of study

Please try to give an over-all rating of the four examples you have seen. Rate them as if you were in a remote class and this was your communication link with the instructor. Which example was most applicable to the teaching/learning process? Consider factors such as frame time, resolution, etc., in your evaluation.

Rate in descending order. 1=best and 4=worst

Presentation #1_____

Presentation #2_____

Presentation #3_____

Presentation #4_____

COMMENTS: Please make any comments which would help amplify your answers. Also, any impressions as to the suitability of Controlled Scan Televideo to instructional usage. Finally, any other pertinent comments.

_____

_____

_____

_____

APPENDIX C

REVISED EXPERIMENTAL QUESTIONNAIRE

Controlled Scan Televideo Questionnaire

You have been selected to take part in an experiment involving slow scan television, or what is probably a better term, Controlled Scan Televideo. This questionnaire will be used to gain knowledge about the suitability of Controlled Scan Televideo for teaching in situations where teacher and student cannot be in a face-to-face learning environment.

You will be watching four short videotapes which display instructional material. Each lesson will contain the same information. After each videotape has been shown you will be asked to evaluate the physical aspects of the slow scan demonstration on a short evaluation form.

Please fill out the following information. The request for your I.D. number is in case I need to gain any additional information from you in the future. Your answers will remain anonymous and it is highly unlikely that I will need any further information.

Year in School _____

Major _____

WSU I.D. #_____

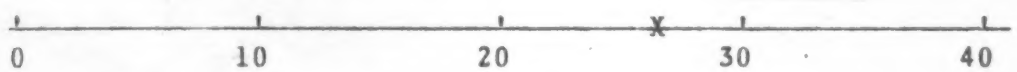
For your participation in this experiment I offer my sincere thanks.

Don Peters
Graduate Student,
Adult and Continuing Education

The following is an example of the way of marking your response to the questions on the questionnaire. Place a mark on the scale after each statement which most nearly describes your reaction to that statement.

For example:

The number of hours per week I spend studying is:



I spend 28 hours per week studying so I checked the point on the scale corresponding to 28.

Place a mark on the scale after each statement (1 through 8) which describes your reaction to Videotape #1.

1. The written information was:

(1)	(2)	(3)	(4)	(5)
Not Readable	Hard to Read	Readable	Mostly Readable	Highly Readable

2. The graphic information was:

Not Readable	Hard to Read	Readable	Mostly Readable	Highly Readable

3. The photographic detail was:

Unrecog-nizable	Recog-nizable	Acceptable	Good	Very Good

4. The overall resolution or clarity of the image was:

Fuzzy, Poorly Defined	Somewhat Fuzzy	Adequate	Well Defined	Crisp and Clear

5. The time required for a new image to appear on the screen was:

Much Too Long	Too Long	About Right	Too Short	Much Too Short

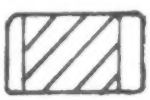
6. The direction (top-to-bottom or left-to-right) from which the new image arrived on the screen was:

Highly Distracting	Distracting	Acceptable	Appealing	Highly Appealing

7. Did you correlate the picture with the narration?

Never	Almost Never	Sometimes	Usually	Always

8. The shape of the picture information area I viewed was:

Square  ( ) Rectangular ( ) [check one]

The shape of the picture information area I viewed was:

Highly Undesirable	Undesirable	Acceptable	Desirable	Highly Desirable

Additional Information

Please indicate the approximate distance in feet you were from the television monitor.

_____feet

Please indicate the type and amount of exposure you have had to instructional television.

1. Broadcast Instructional television:

None	Slight	Occasional lesson	Series of lessons	Full course of study

2. Videotape:

None	Slight	Occasional lesson	Series of lessons	Full course of study

3. Two-way television:

None	Slight	Occasional lesson	Series of lessons	Full course of study

4. Other (please describe) _____

_____

Please try to give an overall rating of the four examples you have seen. Rate them as if you were in a remote class and this was your communication link with the instructor. Which example was most applicable to the teaching/learning process? Consider factors such as frame time, resolution, direction of image change, etc. in your evaluation.

Rate the examples from 1 to 4. 1=best 4=worst

Presentation #1____

Presentation #2____

Presentation #3____

Presentation #4____

COMMENTS: Please make any comments which would help amplify your answers. Also, any impressions as to the suitability of Controlled Scan Televideo to instructional usage. Finally, any other pertinent comments.

_____

_____

APPENDIX D

COMPARISON OF SLOW-SCAN TELEVISION SYSTEMS

Comparison of Slow-Scan Television Systems

Manfacturer	Cost	Frame Time	Scanning System	Resolution	Gray Scale
Robot Research Inc.					
Model 530 Transceiver	$ 1695	8.5 seconds	Top-to-Bottom	128 horizontal x 128 vertical elements	16 levels
Model 630 Transceiver	4890	35 sec.	Top-to-Bottom	256 h. x 265 v.	64 levels
Colorado Video, Inc.[a]					
Model 260B compressor	2500	34/78 sec.	Left-to-Right	Dependent upon Expander	
Model 275A Expander	6000	34 sec.	Left-to-Right	256 h. x 256 v.	64 levels
Model 275B Expander	7500	78 sec.	Left-to-Right	512 h. x 256 v.	64 levels
Nippon Electric Co., Ltd. (NEC)					
Model TVS-751TR Color Transceiver[b]	19000	150/300 sec.[c]	Top-to-Bottom	350 h. x 190 v.	256 levels
Model TVS-754TR B&W Transceiver[b]	17000	30 sec.	Top-to-Bottom	280 h. x 190 v.	256 levels
Delphi Systems					
Model DS-706 Transceiver[d]	5000-7000	35 sec.	Top-to-Bottom[e]	256 h. x 256 v.	64 levels

[a]Consists of separate transmitter (compressor) and receiver (expander), requires two of each unit for a full two-way system.

[b]Features an optional real-time pointer.

[c]These figures for voice grade circuits. Frame time is .5 to 75 seconds with data lines.

[d]Features two memories allowing the display of two simultaneous frames with two monitors or sub rosa transmission of new frames with instantaneous switching from old to new frame when using only one monitor.

[e]System can transmit to, but not receive from, a Robot Model 630.

MANUFACTURERS OF SLOW-SCAN TELEVISION EQUIPMENT

Colorado Video, Incorporated
Box 928
Boulder, Colorado 80396

Dephi Systems Division,
Information & Communications Applications
6110 Executive Boulevard
Rockville, Maryland 20852

Nippon Electric Co., Ltd.
NEC America, Inc.,
Broadcast Equipment Division
130 Martin Lane
Elk Grove, Illinois 60007

Robot Research, Inc.
7591 Convoy Court
San Diego, California 92111

APPENDIX E

TABULATION OF VOICE AND VIDEO CIRCUIT TRANSMISSION COSTS

Transmission Costs

Costs for various transmission lines between Washington State University at Pullman and Richland, Washington (106 circuit-miles) are listed below.

1. Voice grade circuits allow two-way slow scan with a 30 second or longer frame time.
2. Eight kilohertz circuits allow two-way SSTV with an 8 to 10 second frame time.
3. The video circuit listed allows one-way, full motion television.

These circuits are for the carriage of the visual portion of the message only. An additional voice grade circuit would be required to carry the audio portion.

COSTS OF VARIOUS CIRCUITS

Channel	Occasional Use	Monthly Costs	Pro Rata Per Hour[a]
Voice grade			
Direct Dial Dedicated line	$16.95/hr.	$577	$14.43/hr.
SCAN (State Controlled Area Network)	4.20/hr.		
8 Kilohertz	$42.20 + 28.62/hr. (71.42 for 1 hr.)	$1035 + 5.14 per use	28.45/hr.
Video[b]	$5935 first day + 175/day for following days	$8260	206.50/hr.

[a]Based on two hours use per day, 20 days per month.

[b]To Yakima, Wa.--nearest point to Richland served by Western Telecommunications, Inc.

Rates for telephone circuits were obtained from General Telephone of the Northwest. Video rate was obtained from Western Telecommunications, Inc. and represents an initial estimate only.